

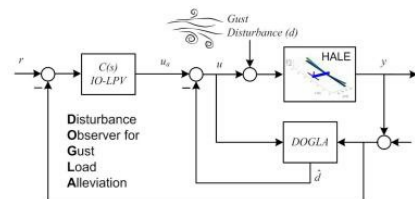
Gust load estimation and rejection with application to robust flight control design for HALE aircraft Project

SBIR/STTR Programs | Space Technology Mission Directorate (STMD)



ABSTRACT

High Altitude Long Endurance (HALE) aircraft have garnered increased interest in recent years as they can serve several purposes, including many of the objectives of satellites while incurring a fraction of the cost to deploy. Examples applications include Intelligence, Surveillance, and Reconnaissance, communications relay systems, and environmental and atmospheric sensing. The requirements for HALE aircraft dictate that they have very high lift-to-drag ratios, and are extremely lightweight, resulting in high aspect ratios with significant structural flexibility. This results in a dynamically nonlinear vehicle with highly coupled rigid body and aeroelastic structural dynamics. Atmospheric turbulence and gust loading of substantial variance can significantly impact the performance of HALE aircraft. Due to the vast importance of gust loading on these lightweight aircraft platforms, Systems Technology, Inc. and the University of Michigan propose the development of the Disturbance Observer for Gust Load Alleviation (DOGLA) where the gust loading will be actively estimated and subsequently rejected. DOGLA will be implemented on a nonlinear HALE aircraft model in conjunction with a robust primary flight control design. Both the disturbance observer and primary flight control designs will be implemented within a novel gain-scheduling framework to address nonlinear dynamics and varying flight conditions.

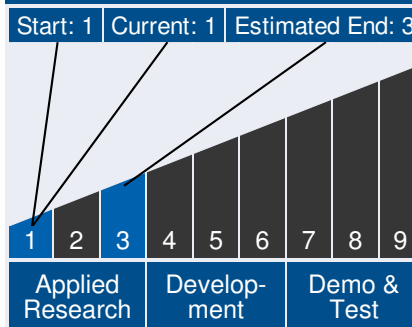


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Technology Maturity



Management Team

Program Executive:

- Joseph Grant

Principal Investigator:

- Brian Danowsky

ANTICIPATED BENEFITS

To NASA funded missions:

Potential NASA Commercial Applications: DOGLA falls under the NASA Aeronautical Research Mission Directorate (ARMD), which in 2014 announced six research thrusts. DOGLA applies to several of these thrusts. First, DOGLA directly contributes to the "assured autonomy for aviation transformation" thrust by allowing an automatic system to alleviate gust loading without impacting performance of the primary flight control system. The

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proposed innovation also supports the "real-time, system-wide safety assurance" and "ultra-efficient commercial vehicles" research thrusts. In terms of specific ARMD programs, DOGLA applies to: 1) the Fundamental Aeronautics Program wherein DOGLA provides an advanced technology to improve performance of current and future air vehicles; 2) Aviation Safety Program wherein the technology supports assurance of flight critical systems and assurance of safe and effective aircraft control under hazardous conditions; and 3) the Aeronautics Test Program wherein the technology can enhance test operations of new, novel technology demonstrators including the NASA Global Hawk HALE and the X-56A.

To the commercial space industry:

Potential Non-NASA Commercial Applications: DOGLA has application to the worldwide aircraft manufacturing industry of both manned and unmanned aircraft, with focus on HALE aircraft. Current DoD programs that will benefit from DOGLA include the Boeing Phantom Eye and the DARPA Vulture, which are for long endurance advanced ISR, driven by current US military combat conditions. In the commercial market, HALE vehicles are garnering interest as communications relay systems. Both Google and Facebook are pursuing HALE technology to provide internet access to remote areas. Google and Facebook have recently purchased Titan Aerospace and Ascenta respectively, who have been developing solar powered HALE UAS for this purpose. Other companies that specialize in HALE aircraft that would benefit from DOGLA include Aurora Flight Sciences (Perseus and Theseus aircraft) and Solar Flight (Sunseeker and SUNSTAR solar powered aircraft). DOGLA has application to non-HALE flexible aircraft as well, and this includes airliners developed by both Boeing and Airbus.

Technology Areas

Remote Observation Platforms for Earth Entries (TA 9.4.6.6)

Robotics and Autonomous Systems (TA 4)

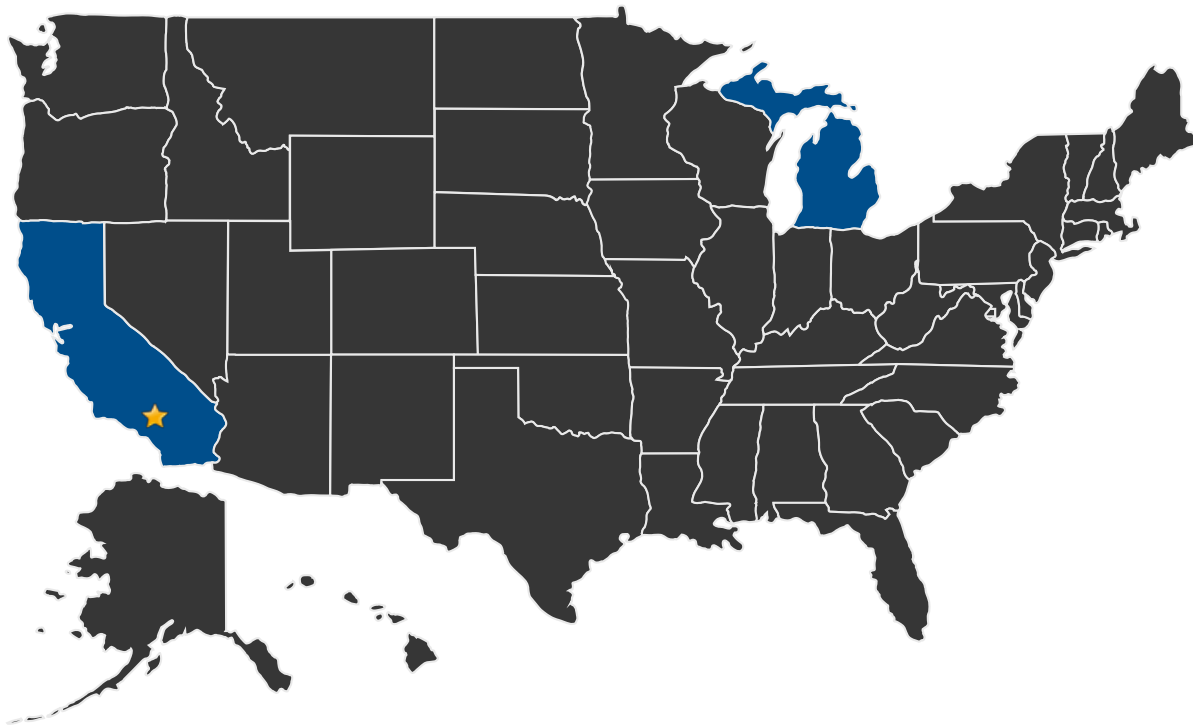
└ Adjustable Autonomy (TA 4.5.5)

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U.S. WORK LOCATIONS AND KEY PARTNERS



■ U.S. States With Work

★ **Lead Center:**
Armstrong Flight Research Center

Other Organizations Performing Work:

- Systems Technology, Inc. (Hawthorne, CA)
- University of Michigan (Ann Arbor, MI)

PROJECT LIBRARY

Presentations

- Briefing Chart
 - (<http://techport.nasa.gov:80/file/18190>)

Active Project (2015 - 2016)

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DETAILS FOR TECHNOLOGY 1

Technology Title

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